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Matsuno

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(54) **IMAGE FORMING APPARATUS INCLUDING AN OPENING/CLOSING DETECTING DEVICE**

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(51) **Int. Cl.**
G03G 21/00 (2006.01)
G03G 21/16 (2006.01)
G03G 15/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/1633*** (2013.01); *G03G 15/55* (2013.01)

(58) **Field of Classification Search**
CPC G03G 21/1633
USPC 399/110
See application file for complete search history.

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(57) **ABSTRACT**

An image forming apparatus includes an opening/closing member, an opening/closing detecting device and an operating member. The opening/closing member turns integrally with a supporting shaft around the supporting shaft. The opening/closing detecting device detects an opening/closing state of the opening/closing member. The operating member turns integrally with the supporting shaft so as to interlock with turning of the opening/closing member. The operating member includes a pressing part having an external circumference face around the supporting shaft and a relief part having an external circumference face inside a rotation locus of the pressing part. The opening/closing detecting device includes a switch part switching between an ON position depressed by the pressing part in accordance with turning of the operating member, and an OFF position depressing-released by the relief part in accordance with turning of the operating member, and detects the opening/closing state of the opening/closing member by switching the switch part.

11 Claims, 13 Drawing Sheets

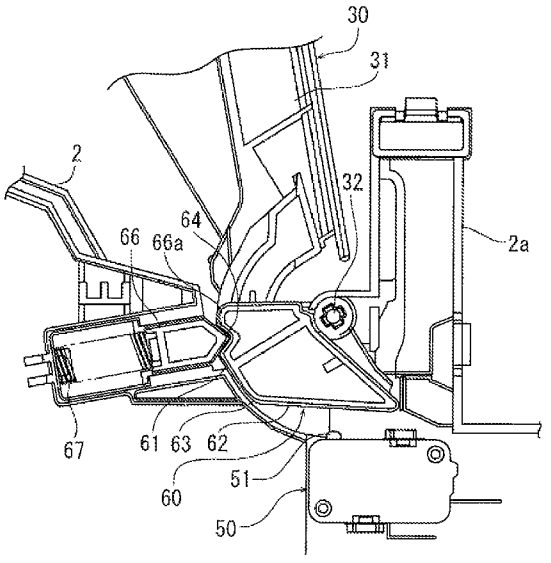


FIG. 1

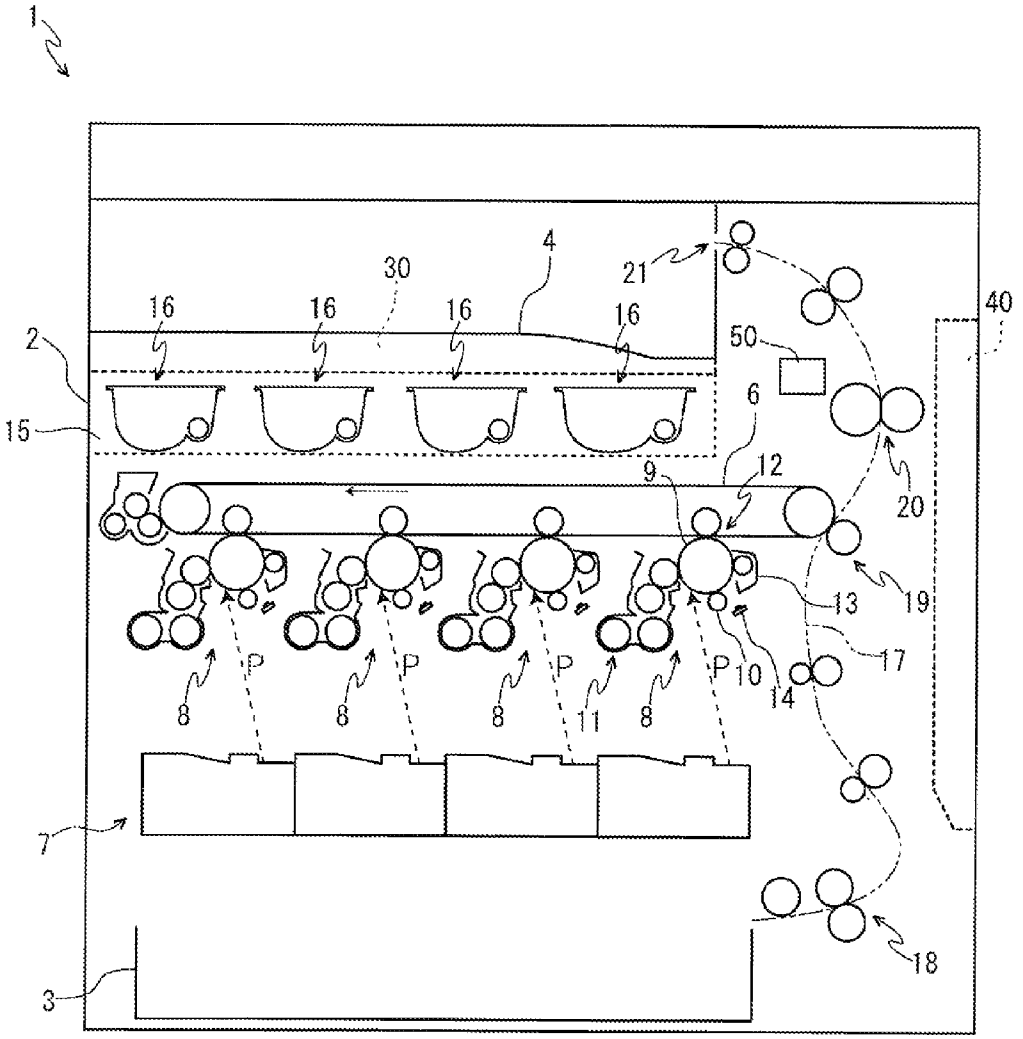


FIG. 2

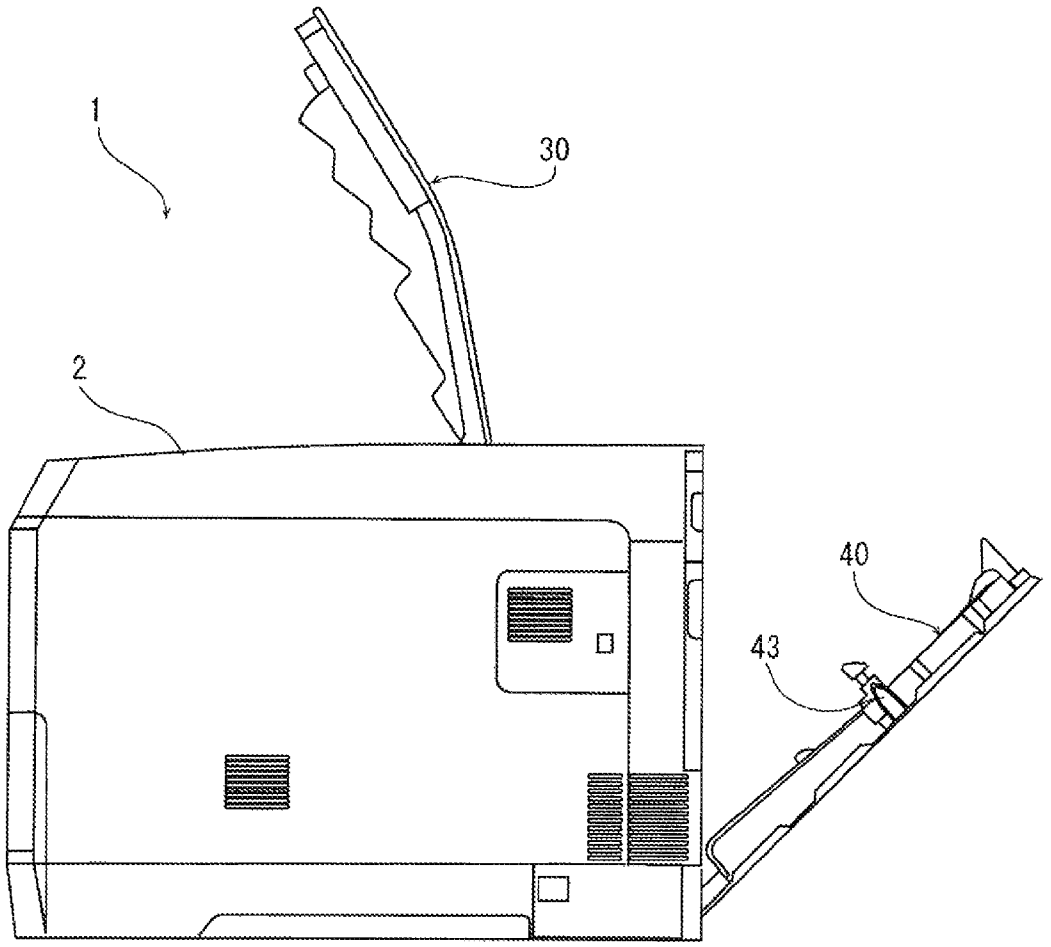


FIG. 3

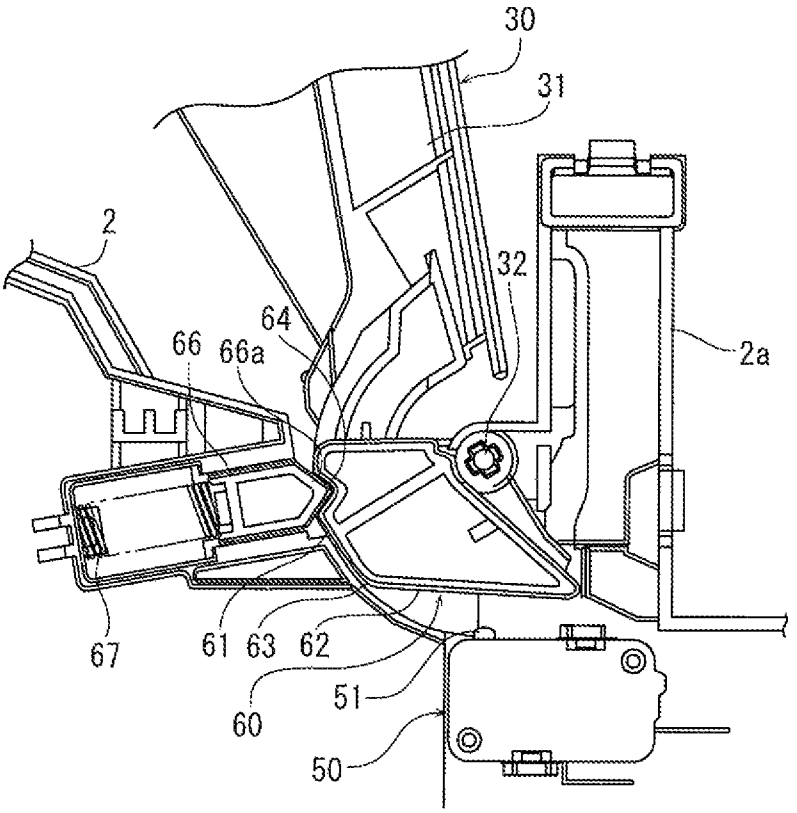


FIG. 4

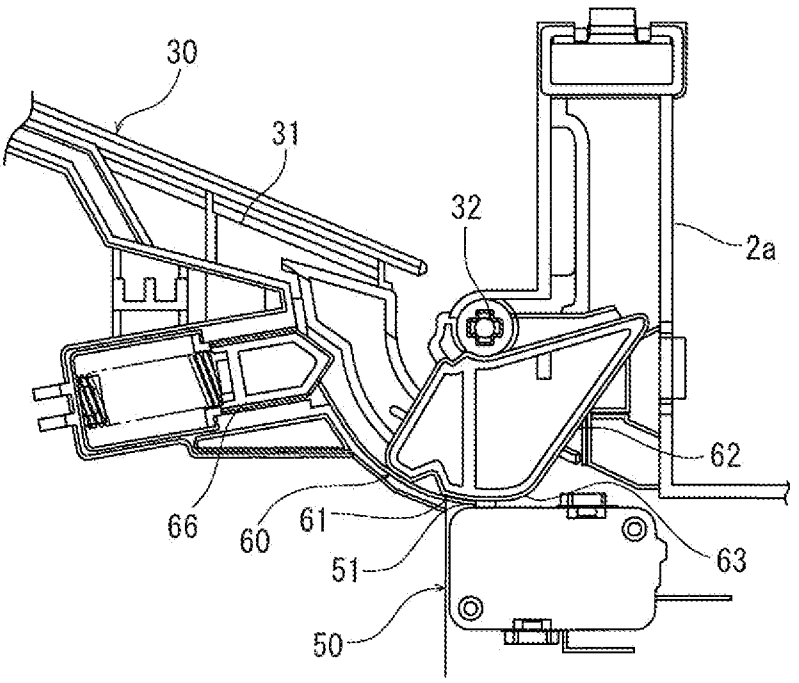


FIG. 5

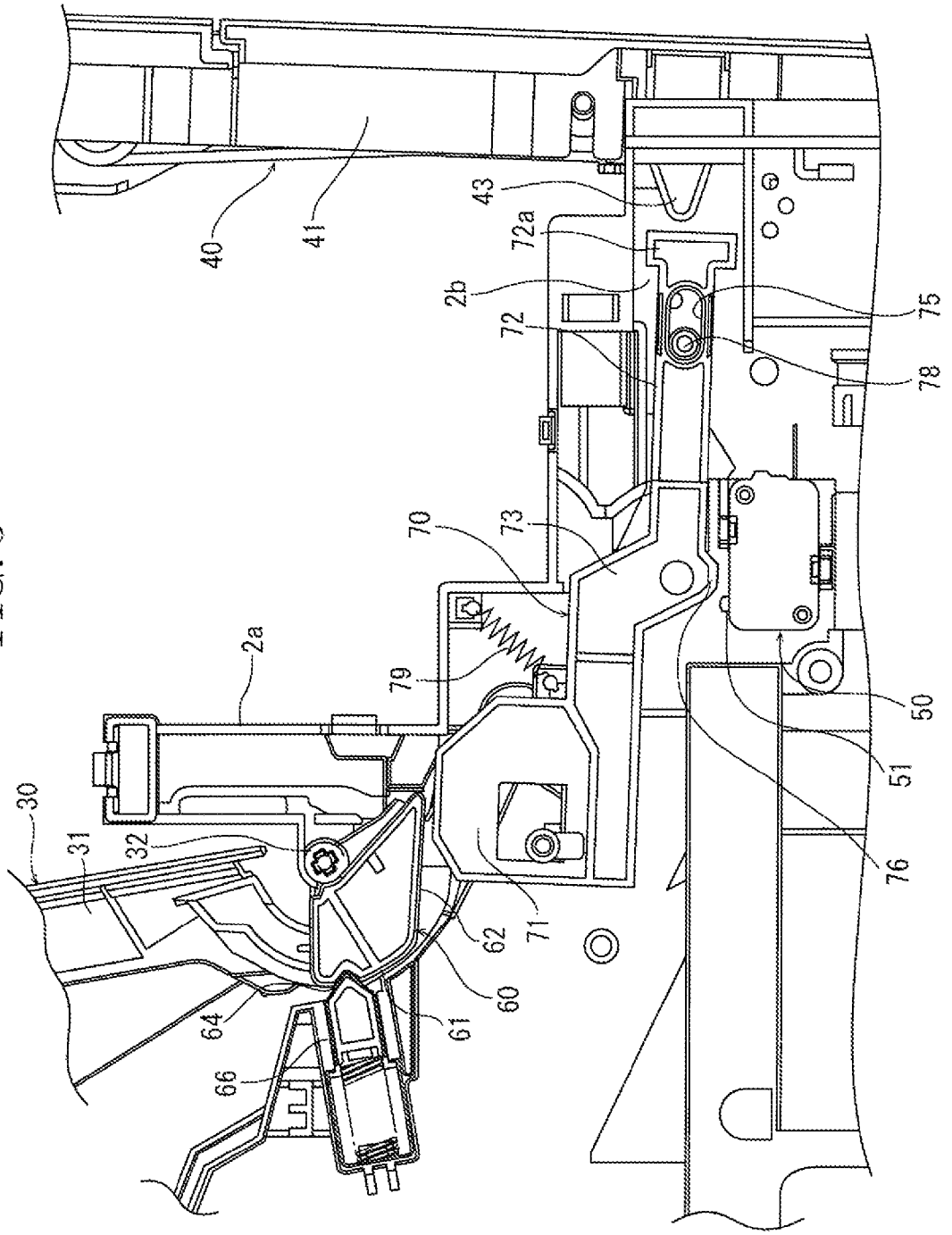


FIG. 6

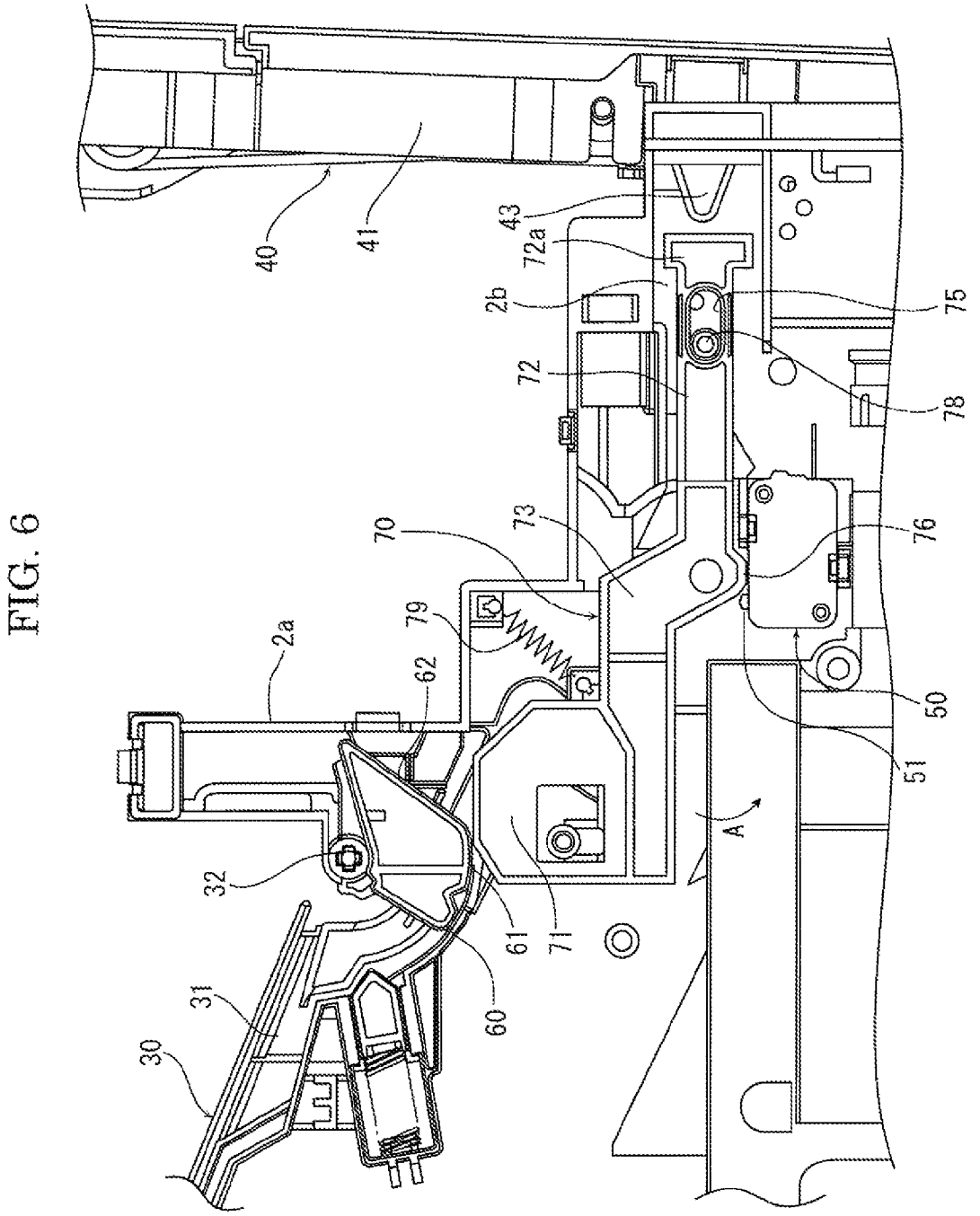
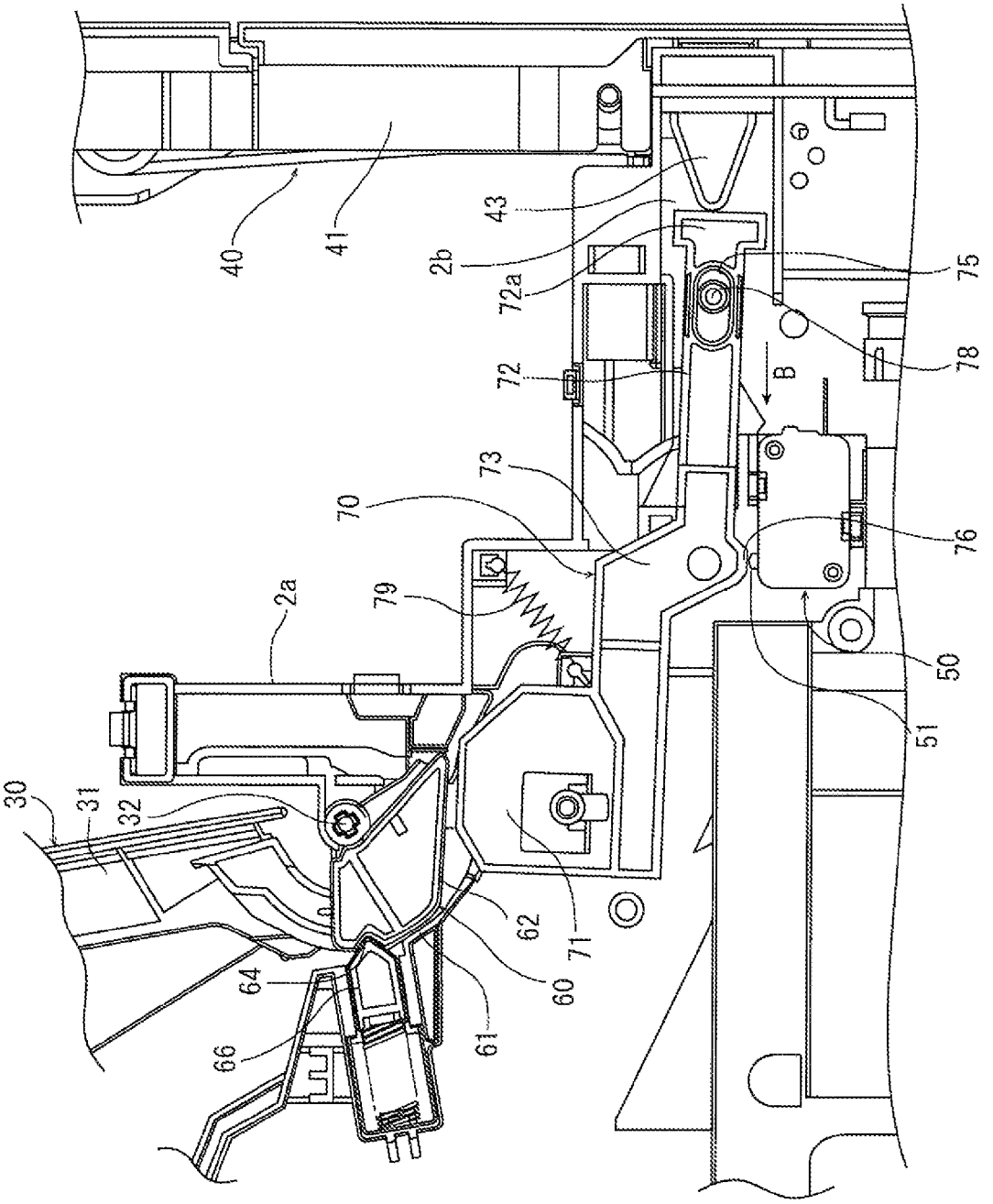


FIG. 7


40
41
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2b
72a
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78
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B
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2a
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66
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FIG. 8

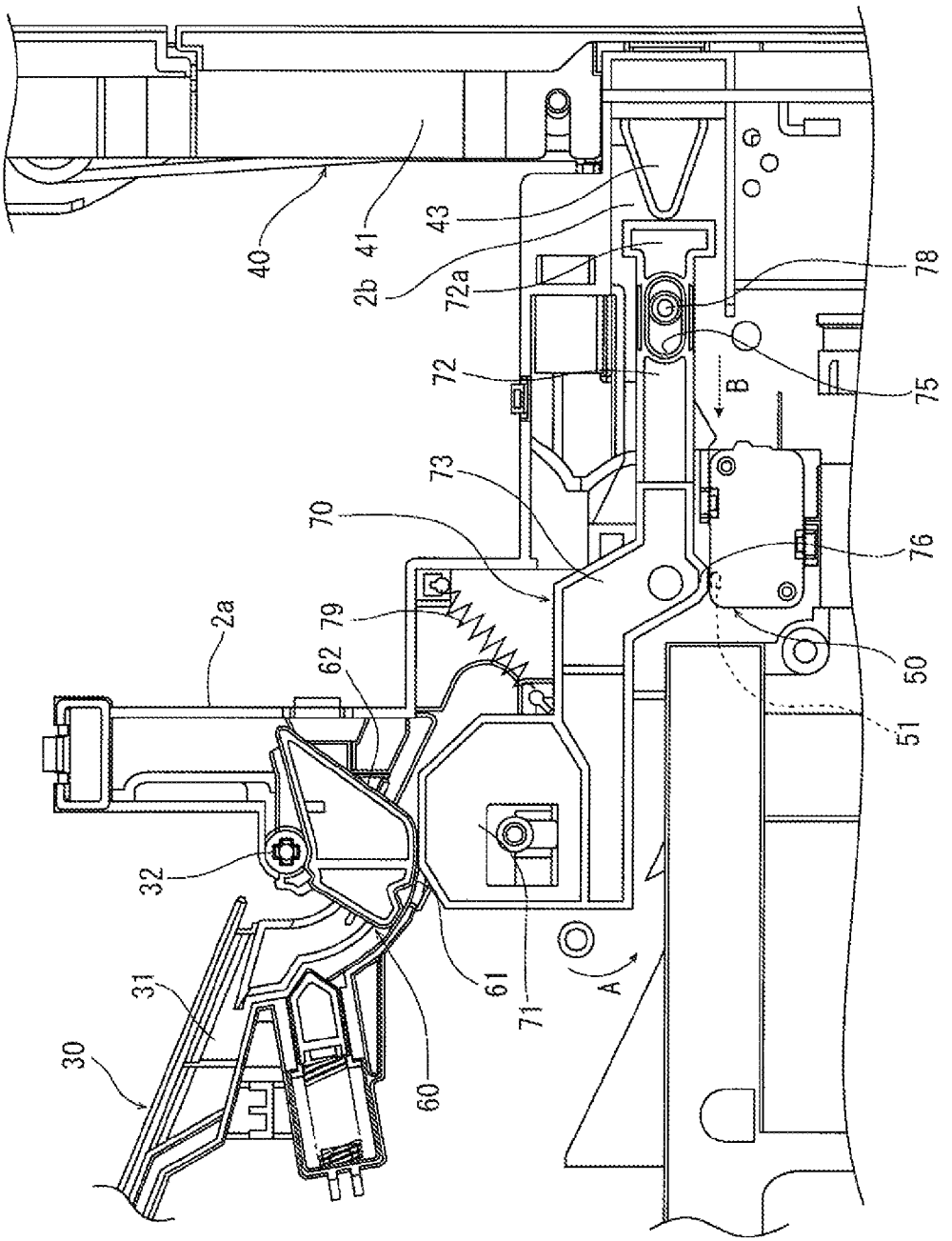

FIG. 9

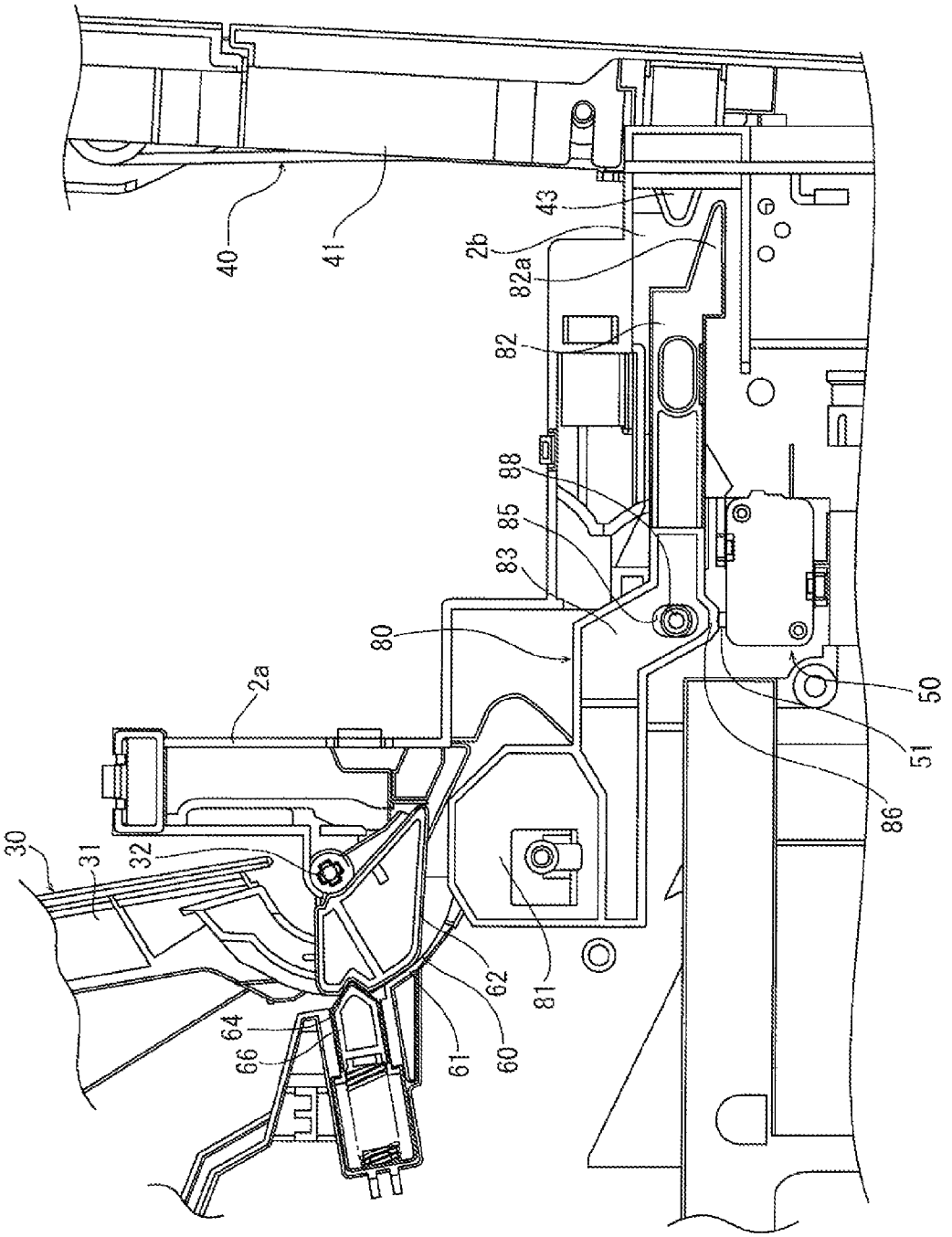

FIG. 10

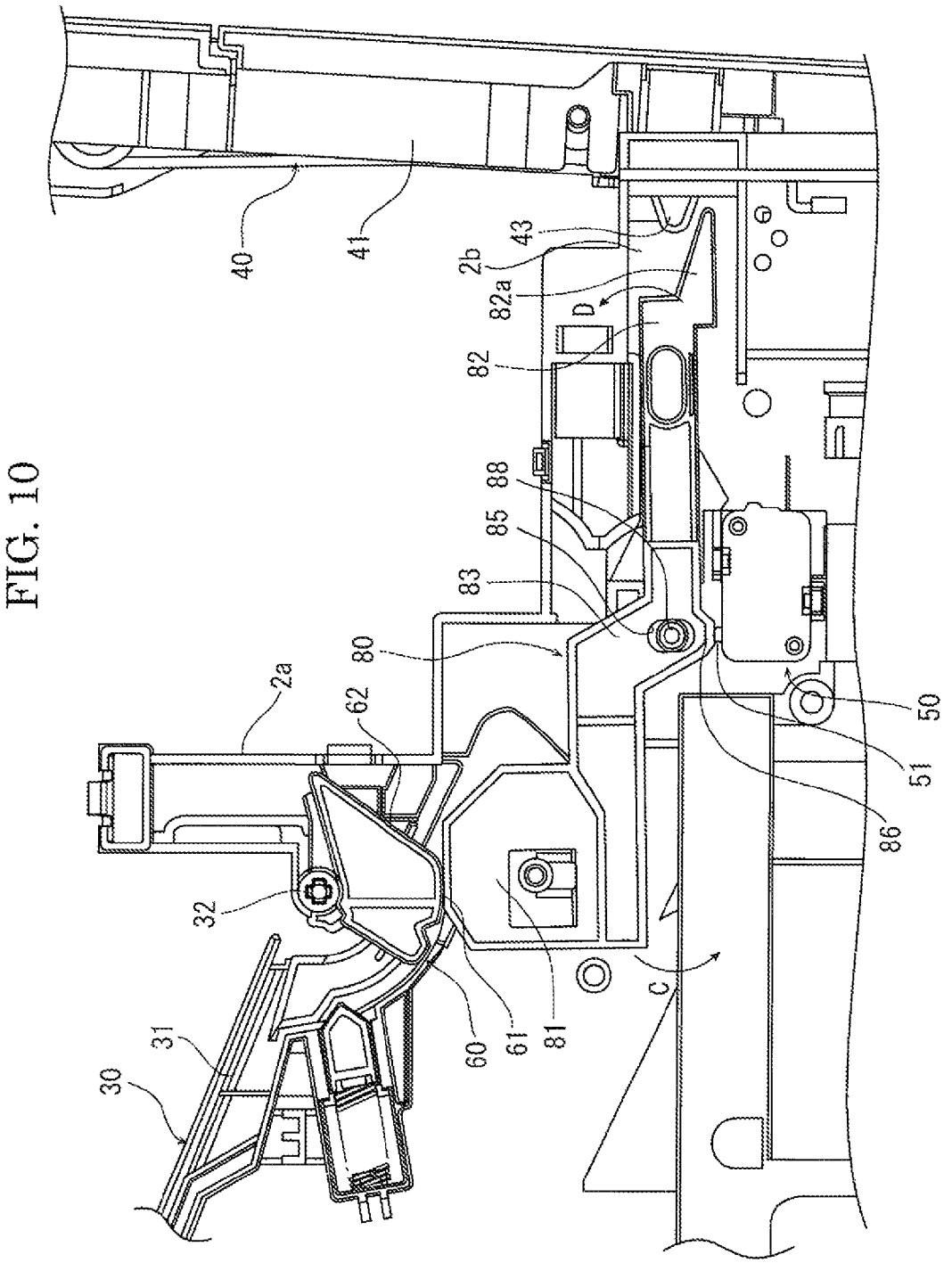

FIG. 11

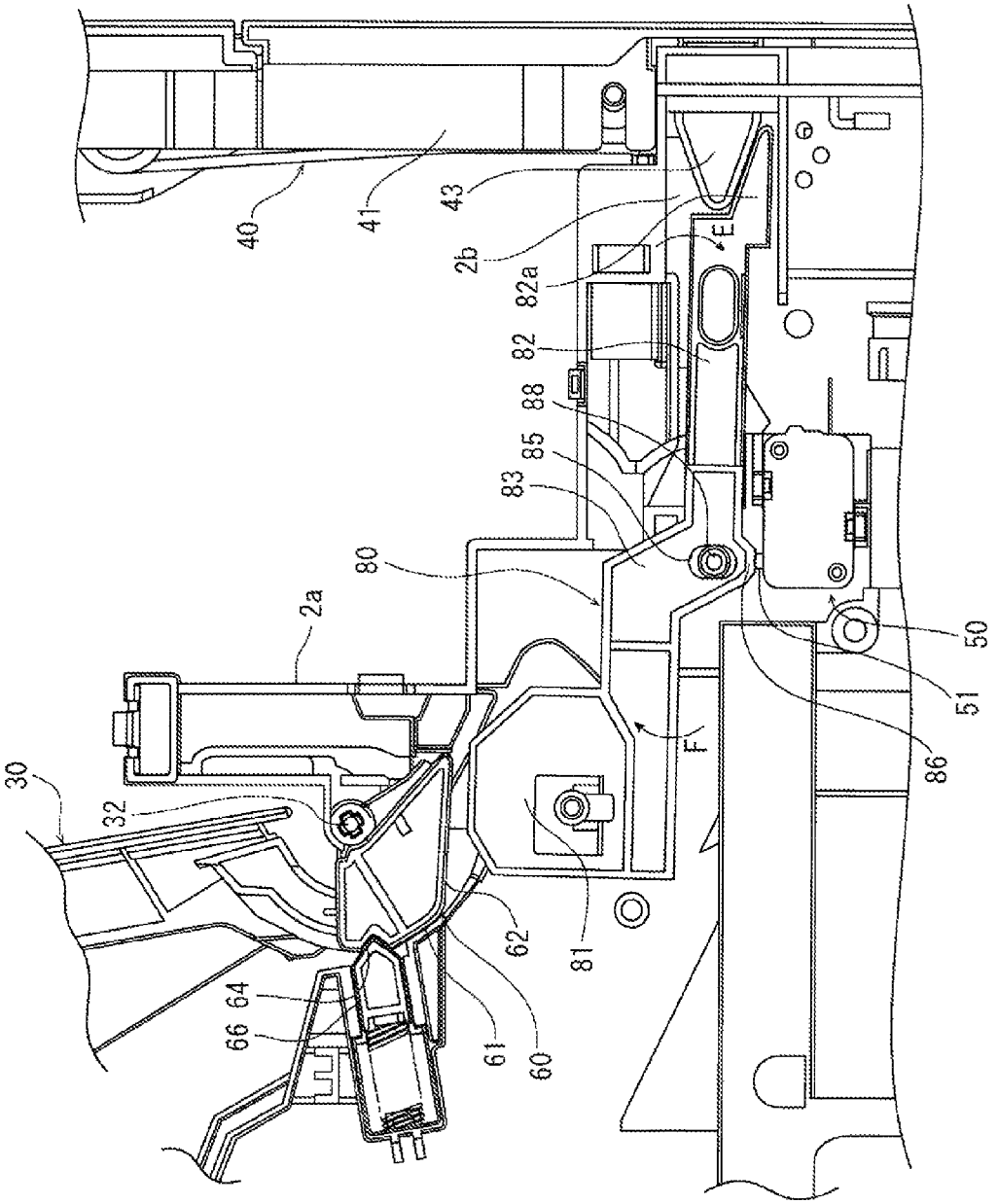

FIG. 12

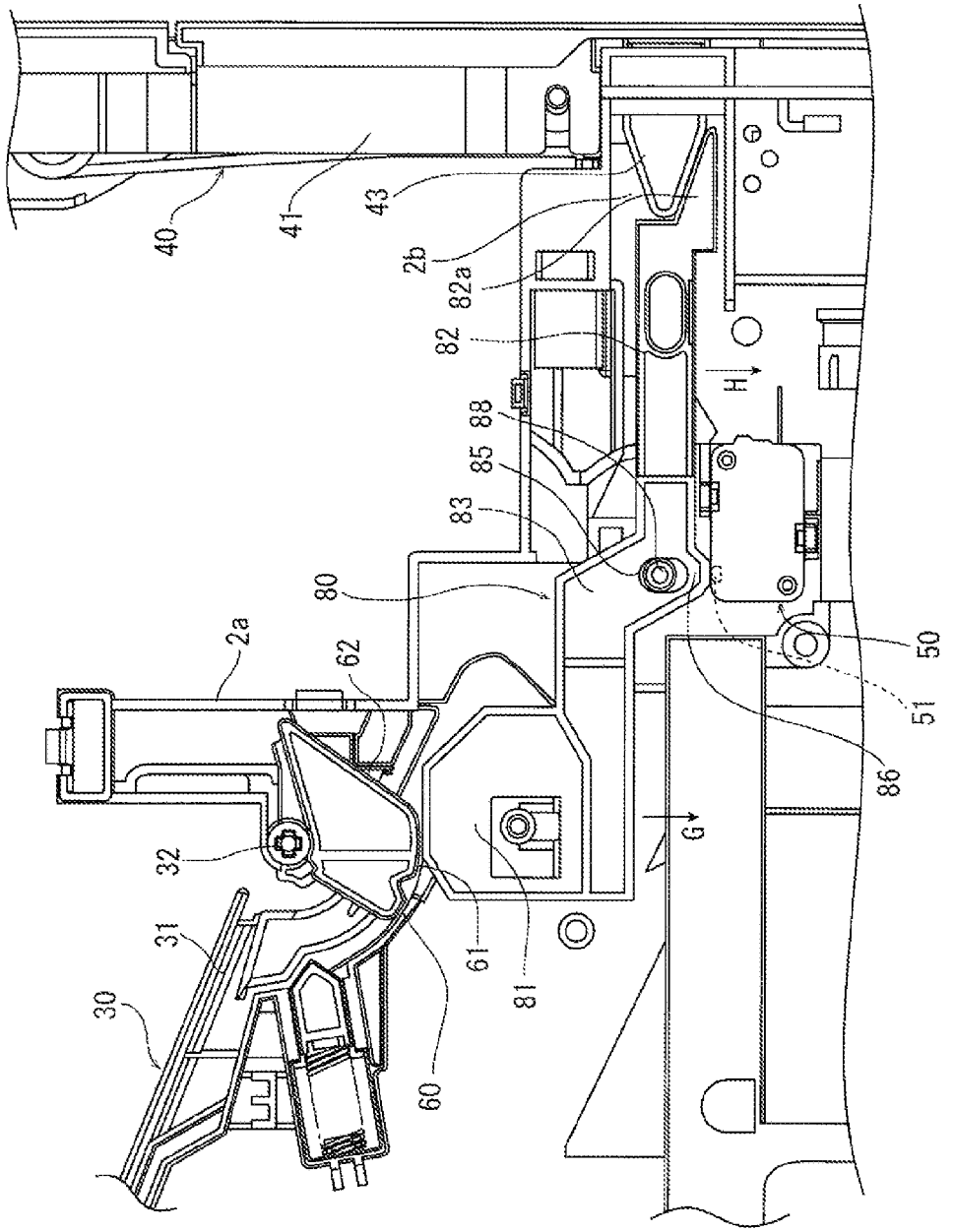

FIG. 13

Related Art

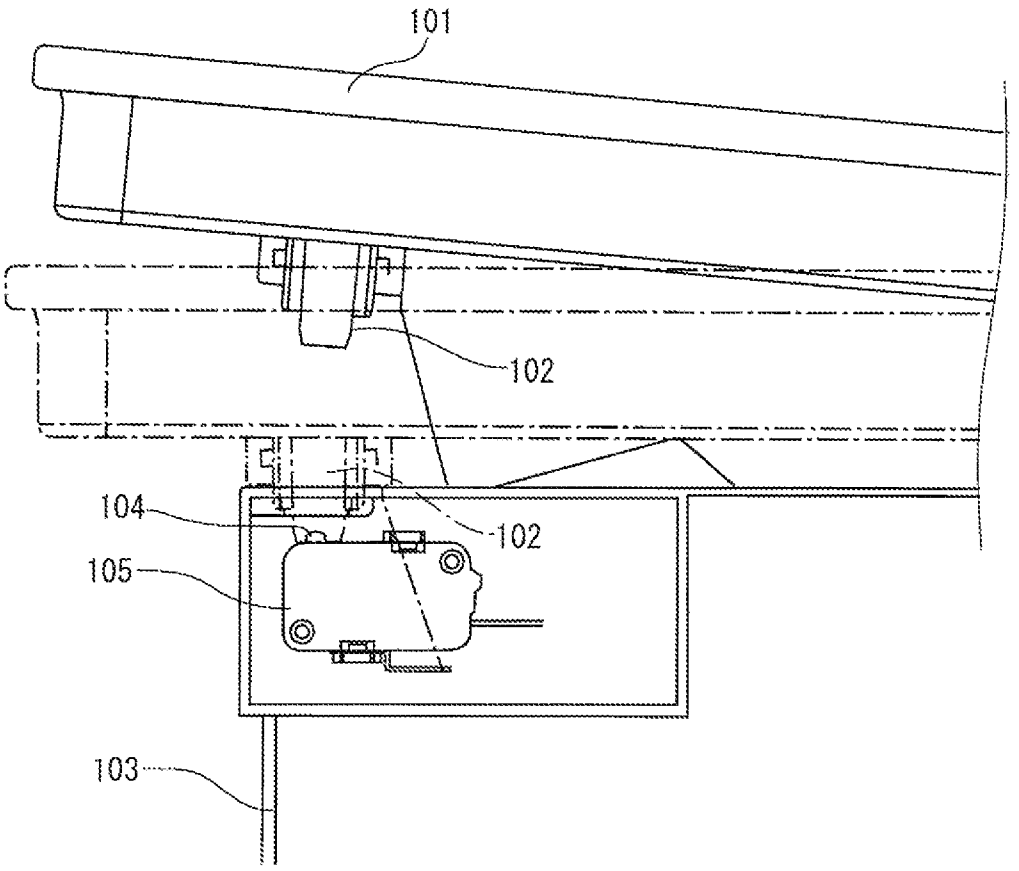

IMAGE FORMING APPARATUS INCLUDING AN OPENING/CLOSING DETECTING DEVICE

INCORPORATION BY REFERENCE

This application is based on and claims the benefit of priority from Japanese Patent application No. 2013-269808 filed on Dec. 26, 2013, the entire contents of which are incorporated herein by reference.

BACKGROUND

The present disclosure relates to an image forming apparatus including an opening/closing detecting device detecting an opening/closing state of an opening/closing member.

An image forming apparatus is configured so that a toner container installing part and a sheet conveying part arranged inside the apparatus are opened/closed by an opening/closing member in order to process a replacement of a toner container and a paper jam. In the image forming apparatus including such an opening/closing member, generally, an opening/closing detecting device detecting an opening/closing state of the opening/closing member is arranged in order to prevent the apparatus from starting to operate by mistake in a condition where the opening/closing member is not closed.

A conventional example of the image forming apparatus including the opening/closing member will be described with reference to FIG. **13**. In a top end part of an inner face of the opening/closing member **101**, a protruding part **102** protruding downwardly is arranged and, in a main body part **103**, the opening/closing detecting device **105** is arranged at a corresponding position to the protruding part **102** in a case of closing the opening/closing member **101**. In the opening/closing detecting device **105**, a depressing-type switch part **104** is arranged. As indicated by a chain line in FIG. **13**, when the opening/closing member **101** is closed and the switch part **104** is depressed by the protruding part **102**, the opening/closing detecting device **105** is operated to detect a closing state of the opening/closing member **101**.

Moreover, an image forming apparatus detecting opening/closing states of two opening/closing members by one opening/closing detecting device is known. In this image forming apparatus, in a center part of an inner face of one opening/closing member and a top end part of an inner face of another opening/closing member, protruding parts are respectively arranged. A switch part of an opening/closing detecting device is configured so as to be depressed by a link mechanism pressed by both the protruding parts.

However, in the conventional image forming apparatus described in FIG. **13**, the protruding part **102** depressing the switch part **104** of the opening/closing detecting device **105** is arranged at the top end of the opening/closing member **101**. Moreover, in the image forming apparatus detecting the opening/closing states of two opening/closing members by one opening/closing detecting device, each protruding part is arranged at the top end or the center part of the respective opening/closing member.

In such a case where the protruding part depressing the switch part of the opening/closing detecting device is arranged at the top end or the center part of the opening/closing member, a position of the protruding part **102** is easily varied by a warp and torsion of the opening/closing member **101** or dispersion of a dimension of the opening/closing member **101**, and therefore, there is possibility that the switch part **104** and link mechanism is not normally depressed. In this case, a problem that a displacement quantity of the switch part **104** and link mechanism is not sufficient and the opening/closing detecting device **105** does not correctly detect the closing state of the opening/closing member **101** is caused.

SUMMARY

In accordance with an embodiment of the present disclosure, an image forming apparatus includes an opening/closing member, an opening/closing detecting device and an operating member. The opening/closing member turns integrally with a supporting shaft around the supporting shaft. The opening/closing detecting device detects an opening/closing state of the opening/closing member. The operating member turns integrally with the supporting shaft. The operating member includes a pressing part and a relief part. The pressing part has an external circumference face in an arc shape around the supporting shaft. The relief part has an external circumference face formed inside a rotation locus of the external circumference face of the pressing part. The opening/closing detecting device includes a switch part configured so as to switch between an ON position, in which the switch part is depressed by the pressing part of the operating member in accordance with turning of the operating member interlocking with turning of the opening/closing member, and an OFF position, in which depressing of the switch part is released by the relief part in accordance with turning of the operating member interlocking with turning of the opening/closing member, and detects the opening/closing state of the opening/closing member by switching the switch part.

The above and other objects, features, and advantages of the present disclosure will become more apparent from the following description when taken in conjunction with the accompanying drawings in which a preferred embodiment of the present disclosure is shown by way of illustrative example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front sectional view schematically showing a structure of a color printer in accordance with a first embodiment of the present disclosure.

FIG. **2** is a front view showing the color printer, in a condition where an upper face cover and a lateral face cover are opened, in accordance with a first embodiment of the present disclosure.

FIG. **3** is a front view showing the upper face cover in an opening state in the color printer in accordance with the first embodiment of the present disclosure.

FIG. **4** is a front view showing the upper face cover in a closing state in the color printer in accordance with the first embodiment of the present disclosure.

FIG. **5** is a front view showing the color printer, when the upper face cover is in the opening state and the lateral face cover is in the opening state, in accordance with a second embodiment of the present disclosure.

FIG. **6** is a front view showing the color printer, when the upper face cover is in the closing state and the lateral face cover is in the opening state, in accordance with the second embodiment of the present disclosure.

FIG. **7** is a front view showing the color printer, when the upper face cover is in the opening state and the lateral face cover is in the closing state, in accordance with the second embodiment of the present disclosure.

FIG. **8** is a front view showing the color printer, when the upper face cover is in the closing state and the lateral face cover is in the closing state, in accordance with the second embodiment of the present disclosure.

FIG. **9** is a front view showing the color printer, when the upper face cover is in the opening state and the lateral face cover is in the opening state, in accordance with a third embodiment of the present disclosure.

FIG. **10** is a front view showing the color printer, when the upper face cover is in the closing state and the lateral face cover is in the opening state, in accordance with the third embodiment of the present disclosure.

FIG. **11** is a front view showing the color printer, when the upper face cover is in the opening state and the lateral face cover is in the closing state, in accordance with the third embodiment of the present disclosure.

FIG. **12** is a front view showing the color printer, when the upper face cover is in the closing state and the lateral face cover is in the closing state, in accordance with the third embodiment of the present disclosure.

FIG. **13** is a front sectional view showing opening and closing states of an upper face cover of a conventional color printer.

DETAILED DESCRIPTION

In the following, with reference the drawings, an image forming apparatus according to embodiments of the present disclosure will be described.

First, with reference to FIGS. **1** and **2**, an entire structure of a color printer **1** (the image forming apparatus) according to a first embodiment of the present disclosure will be described. FIG. **1** is a front view schematically showing a structure of the color printer and FIG. **2** is a front view showing the color printer, in a condition where an upper face cover and a lateral face cover are opened. The structure will be described assuming that the front side of the color printer is positioned at the near side of FIG. **1** and left and right directions are orthogonal to a direction when viewing the color printer from the front side.

The color printer **1** includes a box-formed printer main body **2**. In a lower part of the printer main body **2**, a sheet feeding cartridge **3** storing sheets (recording mediums) is installed and, in an upper part of the printer main body **2**, an ejected sheet tray **4** is provided.

In a center part inside the printer main body **2**, an intermediate transferring belt **6** is disposed around a plurality of rollers. Below the intermediate transferring belt **6**, an exposure device **7** composed of a laser scanning unit (LSU) is arranged. At a lower side of the intermediate transferring belt **6**, four image forming parts **8** are installed for respective colors (e.g. four colors of magenta, cyan, yellow and black) of a toner (a developer). In each image forming part **8**, a photosensitive drum **9** is rotatably attached. Around the photosensitive drum **9**, a charger **10**, a development device **11**, a first transferring part **12**, a cleaning device **13** and a static eliminator **14** are located in order of first transferring processes. Above the development device **11**, a toner container installing part **15** is arranged and toner containers **16** corresponding to the respective image forming parts **8** are arranged in the left and right directions for the respective toner colors. Above the toner container installing part **15**, an upper face cover **30** (an opening/closing member) is arranged so as to turn around a right side, in a part of which the ejected sheet tray **4** is formed. When the toner container **16** is replaced, as shown in FIG. **2**, the upper face cover **30** can be turned and the toner container installing part **15** can be opened.

At the right side inside the printer main body **2**, a conveying path **17** for the sheet is positioned so as to extend vertically from the sheet feeding cartridge **3** to the ejected sheet tray **4**. At an upstream end of the conveying path **17**, a sheet feeding part **18** is positioned. At an intermediate stream part of the conveying path **17**, a second transferring part **19** is positioned at one end (a right end on the figure) of the intermediate transferring belt **6**. At a downstream part of the conveying path **17**, a fixing part **20** is positioned. At a downstream end of the conveying path **17**, an ejection port **21** is positioned. At the right side of the conveying path **17**, a lateral side cover **40** (a second opening/closing member) is arranged so as to turn around a lower side. When a paper jam occurs in the conveying path **17**, as shown in FIG. **2**, the lateral side cover **40** can be turned and the paper jam can be coped.

Next, the operation of forming an image by the color printer **1** having such a configuration will be described. When the power is supplied to the color printer **1**, various parameters are initialized and initial determination, such as temperature determination of the fixing part **20**, is carried out. Subsequently, in the color printer **1**, when image data is inputted and a printing start is directed from a computer or the like connected with the color printer **1**, image forming operation is carried out as follows.

First, the surface of the photosensitive drum **9** is electric-charged by the charger **10**. Then, an electrostatic latent image is formed on the surface of the photosensitive drum **9** by a laser light (refer to an arrow P) from the exposure device **7**. The electrostatic latent image is developed to a toner image having a correspondent color in the development device **11** by the toner supplied from the toner container **16**. The toner image is first-transferred onto the surface of the intermediate transferring belt **6** in the first transferring part **12**. The above-mentioned operation is repeated in order by the respective image forming parts **8**, thereby forming the toner image having full color onto the intermediate transferring belt **6**. Incidentally, toner and electric charge remained on the photosensitive drum **9** are removed by the cleaning device **13** and static eliminator **14**.

On the other hand, the sheet fed from the sheet feeding cartridge **3** by the sheet feeding part **18** is conveyed to the second transferring part **19** in a suitable timing for the above-mentioned image forming operation. Then, in the second transferring part **19**, the toner image having full color on the intermediate transferring belt **6** is second-transferred onto the sheet. The sheet with the second-transferred toner image is conveyed to a downstream side on the conveying path **17** to enter the fixing part **20**, and then, the toner image is fixed on the sheet in the fixing part **20**. The sheet with the fixed toner image is ejected from the ejection port **21** onto the ejected sheet tray **4**.

In the color printer **1**, in order to prevent the color printer **1** from starting to operate by mistake in a condition where the upper face cover **30** is not closed, an opening/closing detecting device **50** detecting an opening/closing state of the upper face cover **30** is arranged.

With reference to FIGS. **3** and **4**, the upper face cover **30** and opening/closing detecting device **50** will be described. FIGS. **3** and **4** are front view showing the upper face cover and opening/closing detecting device, and FIG. **3** illustrates an opening state of the upper face cover and FIG. **4** illustrates a closing state of the upper face cover.

The upper face cover **30** includes a flat rectangular parallelepiped main body part **31** and a supporting shaft **32** arranged along a right side of the main body part **31**. Both ends of the supporting shaft **32** are rotatably supported by a supporting part **2***a* arranged in the printer main body **2**. The main body part **31** is adapted to turn around the supporting shaft **32** between an opening position opening the toner container installing part **15** and a closing position closing the toner container installing part **15**.

In one end of the supporting shaft **32**, an operating member **60** operating the opening/closing detecting device **50** is arranged. The operating member **60** is turned integrally with the supporting shaft **32**, i.e. integrally with the upper face cover **30**. The operating member **60** is a member in a roughly fan-formed front shape around the supporting shaft **32** viewed from the front side with a predetermined thickness.

The operating member **60** includes a pressing part **61** in a fan-formed shape viewed from the front side and a relief part **62** in a triangle shape viewed from the front side. Concretely, the pressing part **61** has an external circumference face in an arc shape around the supporting shaft **32** viewed from the front side. The relief part **62** has an external circumference face in a linear shape viewed from the front side formed inside a rotation locus of the external circumference face of the pressing part **61**. The pressing part **61** and relief part **62** are respectively positioned at a downstream side and an upstream side in an opening direction of the upper face cover **30** (a clockwise direction in FIGS. **3** and **4**). The external circumference face of the pressing part **61** and the external circumference face of the relief part **62** are smoothly continued via a curved part **63**. Near the center in a circumferential direction of the external circumference face of the pressing part **61**, a recess part **64** in a V-shape viewed from the front side is formed.

In the printer main body **2**, a lock member **66** holding the upper face cover **30** at the opening position is supported. The lock member **66** is a quadrangular prism-formed hollow member and has a top end part **66***a* formed in a V-shape viewed from the front side. The lock member **66** is positioned so as to face to the recess part **64** of the pressing part **61** of the operating member **60** at the opening position of the upper face cover **30** as shown in FIG. **3**, and is biased in a direction of the recess part **64** by a coil spring **67**. When the upper face cover **30** is turned to the opening position, the lock member **66** is biased by a coil spring **67** and advanced, and then, the top end part **66***a* is engaged with the recess part **64** of the operating member **60**. Thereby, the operating member **60**, i.e. the upper face cover **30**, is held at the opening position. Incidentally, when the upper face cover **30** is closed, the upper face cover **30** is turned to the closing position, and then, the top end part **66***a* of the lock member **66** is pressed by a lateral face of the recess part **64** of the operating member **60** and released from the recess part **64**, thereby making the upper face cover **30** turnable from the opening position.

The opening/closing detecting device **50** includes a laterally rectangular parallelepiped main body and, on a left end part of an upper face of the main body, a switch part **51** is positioned. As the switch part **51**, for example, a micro switch may be applied. The switch part **51** is an automatic restoration type capable of being depressed by a predetermined load and being restored to a free posture by releasing the depressing. When the switch part **51** is depressed and switched to ON position, the opening/closing detecting device **50** is operated to detect the closing state of the upper face cover **30**. When the depressing of the switch part **51** is released to restore to the free posture, the switch part **51** is switched to OFF position and the opening/closing detecting device **50** becomes non-operating state.

The opening/closing detecting device **50** is fixed by the supporting part **2***a* of the printer main body **2** below the supporting shaft **32** of the upper face cover **30** so that the switch part **51** faces to the external circumference face of the operating member **60**. The opening/closing detecting device **50** is configured so that, when the operating member **60** is turned together with the turn of the upper face cover **30** and the switch part **51** faces to the external circumference face of the pressing part **61**, the switch part **51** is depressed by the pressing part **61** and switched to the ON position, and that, when the upper face cover **30** is turned and the switch part **51** faces to the external circumference face of the relief part **62** of the operating member **60**, the depressing of the switch part **51** is released and switched to the OFF position.

In the color printer **1** with the above-mentioned configuration, a way of detecting the opening/closing state of the upper face cover **30** by the opening/closing detecting device **50** will be described. In the opening position of the upper face cover **30** shown in FIG. **3**, the operating member **60** is positioned so that the external circumference face of the relief part **62** faces to the switch part **51** of the opening/closing detecting device **50** and the top end part **66***a* of the lock member **66** is engaged with the recess part **64** of the pressing part **61**. Therefore, the switch part **51** is positioned at the OFF position and the opening/closing detecting device **50** is not operated. If the upper face cover **30** is started to turn to the closing position, the top end part **66***a* of the lock member **66** is pressed by the lateral face of the recess part **64** of the operating part **60** and released from the recess part **64** and the upper face cover **30** becomes turnable.

When the upper face cover **30** is turned, the operating member **60** is turned together with the supporting shaft **32** and the external circumference face of the pressing face **61** faces to the switch part **51** of the opening/closing detecting device **50** via the curved part **63**. Then, as shown in FIG. **4**, the external circumference face of the pressing face **61** presses the switch part **51** and the switch part **51** is switched to the ON position. Thereby, the opening/closing detecting device **50** is operated and the closing state of the upper face cover **30** is detected.

As described above, in the image forming apparatus **1** according to the first embodiment of the present disclosure, since the switch part **51** of the opening/closing detecting device **50** is switched by turning the operating member **60** arranged in the supporting shaft **32** turning integrally with the upper face cover **30**, it is possible to correctly detect the opening/closing state of the upper cover **30** regardless deformation, such as a warp and torsion, of the main body part **31** of the upper face cover **30**.

In the embodiment, since a moving direction of the external circumference face of the pressing face **61** of the operating member **60** is the circumferential direction and is not different from a vertical direction as a direction depressing the switch part **51**, it is possible to lengthen a moving stroke of the pressing part **61** more than a depressing stroke of the switch part **51**. To stably operate the switch part **51** with a short depressing stroke as the opening/closing detecting device **50** used in the embodiment, it is necessary to improve dimensional accuracy of a member operating the switch part **51** and to increase the stroke via other component. Therefore, by improving the dimensional of a distance between the arc-shaped external circumference face of the pressing face **61** of the operating member **60** and the supporting shaft **32** and by lengthening the moving stroke of the pressing face **61**, it is possible to stably depress the switch part **51**.

Since the external circumference face of the pressing face **61** has the arc shape, if dispersion of an opening/closing angle of the upper face cover **30** occurs, it is possible to ensure constant depressing amount within a range of a central angle of the pressing face **61**.

Since the supporting shaft **32** and opening/closing detecting device **50** are supported by the same supporting part **2***a*, it is easy to achieve positioning accuracy between the operating member **60** and opening/closing detecting device **50** arranged

in the supporting shaft **32** and it is possible to improve detecting accuracy of the opening/closing detecting device **50**.

Next, a color printer according to a second embodiment of the present disclosure will be described with reference to FIGS. **5-8**. In this embodiment, the opening/closing state of the upper face cover **30** and the opening/closing state of the lateral face cover **40** are detected by one opening/closing detecting device **50**. FIG. **5** illustrates the opening position of the upper face cover and an opening position of the lateral face cover, FIG. **6** illustrates the closing position of the upper face cover and the opening position of the lateral face cover, FIG. **7** illustrates the opening position of the upper face cover and a closing position of the lateral face cover, and FIG. **8** illustrates the closing position of the upper face cover and the closing position of the lateral face cover. The upper face cover **30** and opening/closing detecting device **50** have the same structures and shapes as the second embodiment, and therefore, they are indicated by the same reference numerals as the second embodiment and their detail explanations are omitted.

As shown in FIG. **5**, the lateral face cover **40** includes a flat rectangular parallelepiped main body part **41** and a supporting shaft (a supporting shaft, not shown) arranged along a lower side of the main body part **41**. Both ends of the supporting shaft are rotatably supported by the printer main body **2**. As shown in FIG. **2**, the main body part **41** is adapted to turn around the supporting shaft between an opening position opening a right side face of the sheet conveying path **17** and a closing position closing the right side face of the sheet conveying path **17**. Near the center of an inner face of the main body part **41**, a protrusion **43** protruding in an internal direction (a direction closing the right side face of the sheet conveying path **17**) is formed. The protrusion **43** has a triangle shape viewed from the front side. In a lateral face of the printer main body **2**, an opening part **2***b* is formed, into which the protrusion **43** is inserted when the lateral face cover **40** is turned to the closing position.

Between the supporting part **2***a*, to which the supporting shaft **32** of the upper face cover **30** is supported, and the opening part **2***b*, into which the protrusion **43** of the lateral face cover **40** is inserted, a link member **70** operating by opening/closing the upper face cover **30** and lateral face cover **40** is arranged.

The link member **70** is a member elongated in the left and right directions and includes a first pressed part **71** formed in a roughly rectangular parallelepiped shape viewed from the front side, a second pressed part **72** elongated in the left and right directions and an intermediate part **73** formed in a roughly Z-shape between the first pressed part **71** and second pressed part **72**.

The first pressed part **71** has an upper face facing to the external circumference face of the operating member **60** arranged in the supporting shaft **32** of the upper face cover **30**. A center part of the upper face of the first pressed part **71** is a flat face and both sides of the center part are inclined downwardly.

The second pressed part **72** is arranged at a depth side (a left side on FIG. **5**) inside the opening part **2***b* into which the protrusion **43** of the lateral face cover **40** is inserted. The second pressed part **72** is formed in a lateral T-shape viewed from the front side and, in its right end face, a wide width end part **72***a* is formed. A right end face of the end part **72***a* faces to the protrusion **43** of the lateral face cover **40**. At a position at the left side of the second pressed part **72**, a long hole **75** elongated in the left and right directions (a horizontal direction) is formed.

On a lower face of the intermediate part **73**, a convex part **76** in a reverse trapezoid shape viewed from the front side is formed so as to protrude downwardly.

The link member **70** is supported to the printer main body **2** by a shaft **78** movably inserted into the long hole **75** so as to swing around the shaft **78** and to move along the long hole **75** in the left and right directions. That is, when the upper face of the first pressed part **71** is pressed by the pressing part **61** of the operating member **60**, the link member **70** swings around the shaft **78** as a fulcrum in a counter clockwise direction on FIG. **5**. When the right end face of the end part **72***a* of the second pressed part **72** is pressed by the protrusion **43** of the lateral face cover **40**, the link member **70** moves along the long hole **75** in the left direction.

There is a corner between the first pressed part **71** and intermediate part **73** in the link member **70** and, between the corner and printer main body **2**, a coil spring **79** is arranged. The coil spring **79** biases the link member **70** in a clockwise direction around the shaft **78** and in a right direction on FIG. **5**.

The opening/closing detecting device **50** is fixed by the supporting part **2***a* of the printer main body **2** below an external circumference face of the intermediate part **73** of the link member **70** and the switch part **51** faces to an external circumference face of the convex part **76** of the intermediate part **73**. A displacement quantity of the convex part **76** in upward and downward directions produced by swinging the link member **70** is determined so as to be equal to a displacement quantity (the depressing stroke) of the switch part **51** from the ON position to the OFF position. A movement quantity of the convex part **76** in the left and right directions produced by moving the link member **70** in the left and right directions is determined within a distance between a position, in which the convex part **76** faces to the switch part **51**, and another position, in which the convex part **76** is separated from the switch part **51**.

In the color printer **1** with the above-mentioned configuration, a way detecting the opening/closing states of the upper face cover **30** and lateral face cover **40** by the opening/closing detecting device **50** will be described. In a case shown in FIG. **5** where the upper face cover **30** is in the opening position and the lateral face cover **40** is in the opening position, the external circumference face of the relief part **62** of the operating part **60** faces to the upper face of the first pressed part **71** of the link member **70** and the lock member **66** is engaged with the recess part **64** of the pressing part **61** of the operating part **60**. That is, the first pressed part **71** of the link member **70** is not pressed by the pressing part **61**. In addition, the protrusion **43** of the lateral face cover **40** does not come into contact with the end part **72***a* of the second pressed part **72** of the link member **70**. That is, the link member **70** is biased in a clockwise direction around the shaft **78** and in a right direction on FIG. **5** by the coil spring **79**. Incidentally, if the link member **70** is biased upwardly by the coil spring **79**, the first pressed part **71** of the link member **70** is designed so as not to interfere with the relief part **62** of the operating part **60**. Therefore, the convex part **76** formed in the intermediate part **73** of the link member **70** is positioned above the switch part **51** of the opening/closing detecting device **50** and separated from the switch part **51** rightward, the switch part **51** is positioned at the OFF position and the opening/closing detecting device **50** is not operated.

In a case shown in FIG. **6** where the upper face cover **30** is in the closing position and the lateral face cover **40** is in the opening position, the pressing part **61** of the operating part **60** presses the first pressed part **71** of the link member **70**, the link member **70** swings in a counterclockwise direction around

the shaft **78** on FIG. **6** against a biasing force of the coil spring **79** (refer to an arrow A in FIG. **6**) and the convex part **76** is lowered by the depressing stroke of the switch part **51**. However, since the protrusion **43** of the lateral face cover **40** does not come into contact with the end part **72***a* of the second pressed part **72** of the link member **70** and the link member **70** is biased in a right direction by the coil spring **79**, the convex part **76** is separated from the switch part **51** rightward. Therefore, the switch part **51** is positioned at the OFF position and the opening/closing detecting device **50** is not operated.

In a case shown in FIG. **7** where the upper face cover **30** is in the opening position and the lateral face cover **40** is in the closing position, the protrusion **43** of the lateral face cover **40** is inserted into the opening part **2***b* to press the end part **72***a* of the second pressed part **72** of the link member **70**, the link member **70** is moved in the left direction against the biasing force of the coil spring **79** (refer to an arrow B in FIG. **7**) and the convex part **76** is positioned above the switch part **51**. However, since, in the operating part **60**, the relief part **62** faces to the first pressed part **71** of the link member **70**, the lock member **66** is engaged with the recess part **64** of the pressing part **61** and the link member **70** is not pressed by the operating part **60**, the convex part **76** of the link member **70** is positioned above the switch part **51**. Therefore, the switch part **51** is positioned at the OFF position and the opening/closing detecting device **50** is not operated.

In a case shown in FIG. **8** where the upper face cover **30** is in the closing position and the lateral face cover **40** is in the closing position, the pressing part **61** of the operating part **60** presses the first pressed part **71** of the link member **70**, the link member **70** swings in a counterclockwise direction around the shaft **78** on FIG. **8** (refer to an arrow A in FIG. **8**) and the convex part **76** is lowered by the depressing stroke of the switch part **51**. In addition, the protrusion **43** of the lateral face cover **40** is inserted into the opening part **2***b* to press the end part **72***a* of the second pressed part **72** of the link member **70**, the link member **70** is moved in the left direction against the biasing force of the coil spring **79** (refer to an arrow B in FIG. **8**) and the convex part **76** faces to the switch part **51**. Therefore, the convex part **76** of the link member **70** depresses the switch part **51** and the switch part **51** is switched to the ON position. Thereby, the opening/closing detecting device **50** is operated to detect the closing states of the upper face cover **30** and lateral face cover **40**.

As described above, in the embodiment, since the opening/closing states of the upper face cover **30** and lateral face cover **40** can be detected by one opening/closing detecting device **50**, it is possible to reduce the number of components and simplify the configuration of the image forming apparatus.

Moreover, similarly to the first embodiment, in the upper face cover **30**, by improving the dimension accuracy of the distance between the arc-shaped external circumference face of the pressing face **61** of the operating member **60** and the supporting shaft **32**, the link member **70** can be stably swung, and then, the switch part **51** can be stably depressed. On the other hand, in the lateral face cover **40**, by using the link member **70** moving in the left and right directions different from the vertical direction as a direction depressing the switch part **51**, it is possible to increase the moving stroke and stably operate the switch part **51** with the short depressing stroke.

Further, since the link member **70** is supported by the supporting part **22***a* similar to the supporting shaft **32** and the opening/closing detecting device **50**, it is easy to achieve positioning accuracy among the operating member **60** arranged in the supporting shaft **32**, the opening/closing detecting device **50** and the link member **70** and it is possible to improve the detecting accuracy of the opening/closing detecting device **50**.

In the second embodiment, the lateral face cover **40** may be configured so as to be supported movably in the horizontal direction in the printer main body **2** by a supporting member and to open/close. In such a configuration, due to the above-mentioned link member **70**, the opening/closing detecting device **50** can detect the opening/closing of the upper face cover **30** and lateral face cover **40**.

Next, a color printer according to a third embodiment of the present disclosure will be described with reference to FIGS. **9-12**. FIG. **9** illustrates the opening position of the upper face cover and an opening position of the lateral face cover, FIG. **10** illustrates the closing position of the upper face cover and the opening position of the lateral face cover, FIG. **11** illustrates the opening position of the upper face cover and a closing position of the lateral face cover, and FIG. **12** illustrates the closing position of the upper face cover and the closing position of the lateral face cover. The upper face cover **30**, lateral face cover **40** and opening/closing detecting device **50** have the same structures and shapes as the second embodiment, and therefore, they are indicated by the same reference numerals as the second embodiment and their detail explanations are omitted.

The link member **80** is a member elongated in the left and right directions and includes a first pressed part **81** formed in a roughly rectangular parallelepiped shape viewed from the front side, a second pressed part **82** elongated in the left and right directions and an intermediate part **83** formed in a roughly Z-shape between the first pressed part **81** and second pressed part **82**.

The first pressed part **81** has an upper face facing to the external circumference face of the operating member **60** arranged in the supporting shaft **32** of the upper face cover **30**. A center part of the upper face of the first pressed part **81** is a flat face and both sides of the center part are inclined downwardly.

The second pressed part **82** is arranged inside the opening part **2***b* into which the protrusion **43** of the lateral face cover **40** is inserted. In a corner between a right end face and a lower face of the second pressed part **82**, an end part **82***a* with a triangle shape viewed from the front side is formed to protrude in the right direction. The top end part **82***a* has an inclined face inclined downwardly in the right direction. The inclined face of the top end part **82***a* faces to the lower face of the protrusion **43** of the lateral face cover **40**.

Near the center of the intermediate part **83**, a long hole **85** elongated in the upward and downward directions is formed. In a lower face of the intermediate part **83**, a convex part **86** in a reverse trapezoid shape viewed from the front side is formed so as to protrude downwardly.

The link member **80** is supported to the printer main body **2** by a shaft **88** movably inserted into the long hole **85** so as to swing around the shaft **88**, e.g. to do seesaw movement, and to move along the long hole **85** in the upward and downward directions. That is, when the first pressed part **81** is pressed by the pressing face **61** of the operating member **60** arranged in the supporting shaft **32** of the upper face cover **30**, the link member **80** works as the seesaw movement around the shaft **88** so that the first pressed part **81** is lowered and the second pressed part **82** is raised. In addition, when the inclined face of the end part **82***a* of the second pressed part **82** is pressed by the protrusion **43** of the lateral face cover **40**, the link member **80** works as the seesaw movement around the shaft **88** so that the second pressed part **82** is lowered and the first pressed part **81** is raised.

The opening/closing detecting device **50** is fixed by the supporting part **2***a* of the printer main body **2** below an external circumference face of the intermediate part **83** of the link member **80** and the switch part **51** comes in contact with a lower face of the convex part **86** of the intermediate part **83**. The switch part **51** is configured so as to be depressed only when a predetermined load is applied, but the switch part **51** is not depressed only by an empty weight of the link member **80**.

In the color printer **1** with the above-mentioned configuration, a way detecting the opening/closing states of the upper face cover **30** and lateral face cover **40** by the opening/closing detecting device **50** will be described. In a case shown in FIG. **9** where the upper face cover **30** is in the opening position and the lateral face cover **40** is in the opening position, the external circumference face of the relief part **62** of the operating part **60** faces to the upper face of the first pressed part **81** of the link member **80** and the lock member **66** is engaged with the recess part **64** of the pressing part **61** of the operating part **60**, and therefore, the link member **80** is not pressed by the pressing part **61**. In addition, the protrusion **43** of the lateral face cover **40** does not come into contact with the end part **82***a* of the second pressed part **82** of the link member **80**. Therefore, since the convex part **86** formed in the intermediate part **83** of the link member **80** comes into contact with the switch part **51**, but does not depress the switch part **51**, the switch part **51** is positioned at the OFF position and the opening/closing detecting device **50** is not operated.

In a case shown in FIG. **10** where the upper face cover **30** is in the closing position and the lateral face cover **40** is in the opening position, the pressing part **61** of the operating part **60** presses the first pressed part **81** of the link member **80**, but the protrusion **43** of the lateral face cover **40** does not come into contact with the end part **82***a* of the second pressed part **82** of the link member **80**. According to this, the link member **80** works as the seesaw movement around the shaft **88** so that the first pressed part **81** is lowered and the second pressed part **82** is raised (refer to arrows C and D in FIG. **10**), while keeping a posture placed on the switch part **51** of the opening/closing detecting device **50**. Therefore, since the convex part **86** of the link member **80** comes into contact with the switch part **51**, but does not depress the switch part **51**, the switch part **51** is positioned at the OFF position and the opening/closing detecting device **50** is not operated.

In a case shown in FIG. **11** where the upper face cover **30** is in the opening position and the lateral face cover **40** is in the closing position, the protrusion **43** of the lateral face cover **40** is inserted into the opening part **2***b* to press the top end part **82***a* of the second pressed part **82** of the link member **80**, but the relief part **62** faces to the first pressed part **81** of the link member **80** and the lock member **66** is engaged with the recess part **64** of the pressing part **61**. According to this, the link member **80** works as the seesaw movement around the shaft **88** so that the second pressed part **82** is lowered and the first pressed part **81** is raised (refer to arrows E and F in FIG. **11**), while keeping a posture placed on the switch part **51** of the opening/closing detecting device **50**. Therefore, since the convex part **86** of the link member **80** comes into contact with the switch part **51**, but does not depress the switch part **51**, the switch part **51** is positioned at the OFF position and the opening/closing detecting device **50** is not operated.

In a case shown in FIG. **12** where the upper face cover **30** is in the closing position and the lateral face cover **40** is in the closing position, the pressing part **61** of the operating part **60** presses the first pressed part **81** of the link member **80** and the protrusion **43** of the lateral face cover **40** is inserted into the opening part **2***b* to press the end part **82***a* of the second pressed part **82** of the link member **80**. According to this, the first pressed part **81** of the link member **80** is pressed by the pressing part **61** to be lowered and the second pressed part **82** is pressed by the protrusion **43** to be lowered (refer to arrows G and H in FIG. **12**). That is, the link member **80** is lowered along the long hole **85** and the convex part **86** of the link member **80** depresses the switch part **51**. Thereby, the opening/closing detecting device **50** is switched to the ON position to detect the closing states of the upper face cover **30** and lateral face cover **40**.

As described above, in the embodiment, since the opening/closing states of the upper face cover **30** and lateral face cover **40** can be detected by one opening/closing detecting device **50**, it is possible to reduce the number of components and simplify the configuration of the image forming apparatus.

In the embodiment, the lateral face cover **40** may be configured so as to be supported movably in the horizontal direction in the printer main body **2** by a supporting member and to open/close.

Since a distance between the second pressed part **82** as a force point and the shaft **88** as a fulcrum in the seesaw movement of the link member **80** around the shaft **88** is relatively lengthened, it is possible to increase a moving stroke of the second pressed part **82** and stably operate the switch part **51**.

Since the switch part **51** of the opening/closing detecting device **50** is not depressed without applying the predetermined load, a biasing member, such as a coil spring, biasing upwardly the link member **80** is no longer required. However, the biasing member may be provided. In such a case, the biasing member may be arranged so that both sides of the shaft **88** of the link member **80** are biased upwardly.

The embodiments of the present disclosure were described in a case of applying the configuration of the present disclosure to the color printer **1**. On the other hand, in another embodiment, the configuration of the disclosure may be applied to another image forming apparatus, such as a copying machine, a facsimile or a multifunction peripheral, except for the color printer **1**.

While the present disclosure has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present disclosure.

What is claimed is:

1. An image forming apparatus comprising:

an opening/closing member turning integrally with a supporting shaft around the supporting shaft;

an opening/closing detecting device detecting an opening/closing state of the opening/closing member; and

an operating member turning integrally with the supporting shaft,

wherein the operating member includes:

a pressing part having an external circumference face in an arc shape around the supporting shaft; and

a relief part having an external circumference face formed inside a rotation locus of the external circumference face of the pressing part,

the opening/closing detecting device includes a switch part configured so as to switch between an ON position, in which the switch part is depressed by the pressing part of the operating member in accordance with turning of the operating member interlocking with turning of the opening/closing member, and an OFF position, in which depressing of the switch part is released by the relief part in accordance with turning of the operating member interlocking with turning of the opening/closing mem-

ber, and detects the opening/closing state of the opening/closing member by switching the switch part.

2. The image forming apparatus according to claim **1**, wherein

the supporting shaft and the opening/closing detecting device are supported by the same supporting part.

3. The image forming apparatus according to claim **1**, wherein

the pressing part of the operating member is configured to be turned in an orthogonal direction to a depressing direction of the switch part of the opening/closing detecting device.

4. The image forming apparatus according to claim **1**, further comprising:

a second opening/closing member arranged turnably around a second supporting shaft integrally with the second supporting shaft or movably in a predetermined direction by a supporting member, in which its opening/closing state is detected by the opening/closing detecting device; and

a link member including a first pressed part, which is pressed by the pressing part of the operating member in accordance with turning of the operating member interlocking with turning of the opening/closing member and in which pressing is released by the relief part in accordance with turning of the operating member interlocking with turning of the opening/closing member, and a second pressed part pressed by the second opening/closing member,

wherein the opening/closing detecting device is configured so that the switch part is switched to the On position to detect the closing state of the opening/closing member and second opening/closing member when the first pressed part of the link member is pressed by the pressing part of the operating member and the second pressed part of the link member is pressed by the second opening/closing member.

5. The image forming apparatus according to claim **4**, wherein

the second pressed part is pressed in an orthogonal direction to a depressing direction of the switch part of the opening/closing detecting device.

6. The image forming apparatus according to claim **4**, wherein

the link member includes a long hole elongated in a horizontal direction and is configured so as to swing downwardly around a shaft, inserted into the long hole, by the first pressed part pressed by the pressing part of the operating member and to move along the long hole in the horizontal direction by the second pressed part pressed by the second opening/closing member, and then to switch the switch part to the ON position when both the first pressed part and the second pressed part are pressed.

7. The image forming apparatus according to claim **4**, wherein

the link member includes a long hole elongated in upward and downward directions and is configured so as to swing as a seesaw around a shaft, inserted into the long hole, by the first pressed part pressed by the pressing part of the operating member or the second pressed part pressed by the second opening/closing member and to move along the long hole downwardly by the first pressed part pressed by the pressing part of the operating member and the second pressed part pressed by the second opening/closing member, and then to switch the switch part to the ON position when both the first pressed part and the second pressed part are pressed.

8. The image forming apparatus according to claim **4**, further comprising

a biasing member biasing the link member in an opposite direction to a direction in which the first pressed part and second pressed part are pressed.

9. The image forming apparatus according to claim **4**, wherein

the link member is supported by the same supporting part to which the supporting shaft and the opening/closing detecting device are supported.

10. The image forming apparatus according to claim **1**, further comprising

a lock member locking the operating member in an unturnable state at the opening position of the opening/closing member.

11. The image forming apparatus according to claim **4**, wherein

the switch part of the opening/closing detecting device is configured so that depressing or releasing of the depressing is made by a convex part arranged in an intermediate part between the first pressed part and second pressed part of the link member.

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